

Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Original) A method for automatically teaching a reference position which is the reference of the position of a disc-like object in the reference co-ordinate system including the position of a handling device to the handling device of the fore-mentioned disc-like object, comprising a step of determining the center position of a disc-like object with a known radius which was situated at a fixed place being the reference position in the fore-mentioned reference co-ordinate system and a step of memorizing the position of the fore-mentioned fixed place in the fore-mentioned reference co-ordinate system which was determined by calculation based on the fore-mentioned center position in the fore-mentioned handling device as the reference position,

wherein the step of determining the center position of the fore-mentioned disc-like object comprises a step of relatively moving a detection means against the fore-mentioned disc-like object and making one locus of the fore-mentioned detection means cross against the circumference of the fore-mentioned disc-like object,

a step of determining the position of two intersections by the fore-mentioned crossing in the fore-mentioned reference co-ordinate system, and

a step of calculating the fore-mentioned center position using the specific point on the perpendicular bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object.

2. (Original) An automatic reference position teaching method of a disc-like object according to Claim 1, wherein the locus of the fore-mentioned detection means is a circular arc.

3. (Original) A method for automatically positioning a disc-like object with a known radius in the reference co-ordinate system including the position of a handling device of the fore-mentioned disc-like object, comprising a step of determining the center position of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system and

a step of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the step of determining the center position of the fore-mentioned disc-like object comprises a step of relatively moving a detection means against the fore-mentioned disc-like object and making one locus of the fore-mentioned detection means cross against the circumference of the fore-mentioned disc-like object,

a step of determining the position of two intersections by the fore-mentioned crossing in the fore-mentioned reference co-ordinate system, and

a step of calculating the fore-mentioned center position using the specific point on the perpendicular bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object.

4. (Original) A method for automatically positioning a disc-like object with a known radius having one concave portion or one convex portion at one portion of peripheral rim in the reference co-ordinate system including the position of a handling device of the disc-like object, comprising a step of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion in the fore-mentioned reference co-ordinate system and a step of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the step of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion comprises a step of relatively moving a detection means against the fore-mentioned disc-like object and making two loci of the fore-mentioned detection means cross against the peripheral rim of the fore-mentioned disc-like object,

a step of determining the position of two pairs of intersections consisting of two points of each of the pairs by crossing of the fore-mentioned two loci with the peripheral rim of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system,

a step of calculating the center position of a circle when those intersections are situated on a circumference including the fore-mentioned peripheral rim excluding the fore-mentioned concave portion or convex portion using the specific point on the perpendicular

bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object, with respect to the fore-mentioned two pairs, and

a step of selecting the center position of the fore-mentioned disc-like object based on the positional deviation direction of the central point when the fore-mentioned intersections are situated at the fore-mentioned concave portion or convex portion comparing the fore-mentioned two center positions calculated.

5. (Currently Amended) An automatic positioning method of a disc-like object according to Claim 3-~~or~~4, wherein the locus of the fore-mentioned detection means is a circular arc.

6. (Currently Amended) An automatic carrying method of a disc-like object, comprising a step of carrying out the automatic positioning method of the disc-like object according to ~~any one of Claims~~Claim 3-~~to~~5,

a step of correcting a carrying route preliminarily taught of a holding portion of a carrying device as the fore-mentioned handling device based on a transition quantity which was calculated by the fore-mentioned positioning method, and

a step of carrying the fore-mentioned disc-like object to a fixed carrying position with the fore-mentioned holding portion of the fore-mentioned carrying device along the fore-mentioned carrying route corrected.

7. (Original) A device for automatically teaching a reference position which is the reference of the position of a disc-like object in the reference co-ordinate system including the position of a handling device to the handling device of the fore-mentioned disc-like object, equipped with a means of determining the center position of a disc-like object with a known radius which was situated at a fixed place being the reference position in the fore-mentioned reference co-ordinate system and a means of memorizing the position of the fore-mentioned fixed place in the fore-mentioned reference co-ordinate system which was determined by calculation based on the fore-mentioned center position in the fore-mentioned handling device as the reference position,

wherein the means of determining the center position of the fore-mentioned disc-like object has a means of relatively moving a detection means against the fore-mentioned disc-

like object and making one locus of the fore-mentioned detection means cross against the circumference of the fore-mentioned disc-like object,

a means of determining the position of two intersections by the fore-mentioned crossing in the fore-mentioned reference co-ordinate system, and

a means of calculating the fore-mentioned center position using the specific point on the perpendicular bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object.

8. (Original) An automatic reference position teaching device of a disc-like object according to Claim 7, wherein the locus of the fore-mentioned detection means is a circular arc.

9. (Original) A device for automatically positioning the fore-mentioned disc-like object with a known radius in the reference co-ordinate system including the position of a handling device of the disc-like object, equipped with a means of determining the center position of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system and

a means of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the means of determining the center position of the fore-mentioned disc-like object has a means of relatively moving a detection means against the fore-mentioned disc-like object and making one locus of the fore-mentioned detection means cross against the circumference of the fore-mentioned disc-like object,

a means of determining the position of two intersections by the fore-mentioned crossing in the fore-mentioned reference co-ordinate system, and

a means of calculating the fore-mentioned center position using the specific point on the perpendicular bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object.

10. (Original) A device for automatically positioning a disc-like object with a known radius having one concave portion or one convex portion at one portion of peripheral rim in the reference co-ordinate system including the position of a handling device of the disc-like object, equipped with a means of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion in the fore-mentioned reference co-ordinate system and a means of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the means of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion has a means of relatively moving a detection means against the fore-mentioned disc-like object and making two loci of the fore-mentioned detection means cross against the peripheral rim of the fore-mentioned disc-like object,

a means of determining the position of two pairs of intersections consisting of two points of each of the pairs by crossing of the fore-mentioned two loci with the peripheral rim of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system,

a means of calculating the center position of a circle when those intersections are situated on a circumference including the fore-mentioned peripheral rim excluding the fore-mentioned concave portion or convex portion using the specific point on the perpendicular bisector of the section of a line combining the fore-mentioned two intersections, the fore-mentioned two intersections and the radius of the fore-mentioned disc-like object, with respect to the fore-mentioned two pairs, and

a means of selecting the center position of the fore-mentioned disc-like object based on the positional deviation direction of the central point when the fore-mentioned intersections are situated at the fore-mentioned concave portion or convex portion comparing the fore-mentioned two center positions calculated.

11. (Currently Amended) An automatic positioning device of a disc-like object according to Claim 9 or 10, wherein the locus of the fore-mentioned detection means is a circular arc.

12. (Currently Amended) An automatic carrying device of a disc-like object, equipped with the automatic positioning device of a disc-like object according to ~~any one of Claims~~Claim 9 to 11,

a means of correcting a carrying route preliminarily taught of a holding portion of a carrying device as the fore-mentioned handling device based on a transition quantity which was calculated by the fore-mentioned positioning method, and

a means of carrying the fore-mentioned disc-like object to a fixed carrying position with the fore-mentioned holding portion along the fore-mentioned carrying route corrected, by controlling the operation of the fore-mentioned holding portion of the fore-mentioned carrying device.

13. (Original) A method for automatically positioning a disc-like object with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim in the reference co-ordinate system including the position of a handling device of the disc-like object, comprising a step of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion in the fore-mentioned reference co-ordinate system and a step of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the step of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion comprises a step of relatively moving a detection means against the fore-mentioned disc-like object, making three loci of the fore-mentioned detection means cross against the peripheral rim of the fore-mentioned disc-like object and determining the position of 3 pairs of intersections consisting of one pair of 2 points in the fore-mentioned reference co-ordinate system,

a step of selecting a common perpendicular bisector among 3 perpendicular bisectors with respect to the intersections of the fore-mentioned 3 pairs, and

a step of calculating the radius of the fore-mentioned disc-like object and the center position from the specific point on the fore-mentioned common perpendicular bisector and 2 pairs of intersections with respect to the common perpendicular bisector.

14. (Original) An automatic positioning method of a disc-like object according to Claim 13, wherein the locus of the fore-mentioned detection means is a circular arc.

15. (Original) A device for automatically positioning a disc-like object with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim in the reference co-ordinate system including the position of a handling device of the disc-like object, equipped with a means of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion in the fore-mentioned reference co-ordinate system and a means of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the means of determining the center position of the fore-mentioned disc-like object having a concave portion or a convex portion has a means of relatively moving a detection means against the fore-mentioned disc-like object, making three loci of the fore-mentioned detection means cross against the peripheral rim of the fore-mentioned disc-like object and determining the position of 3 pairs of intersections consisting of one pair of 2 points in the fore-mentioned reference co-ordinate system,

a means of selecting a common perpendicular bisector among 3 perpendicular bisectors with respect to the intersections of the fore-mentioned 3 pairs, and

a means of calculating the radius of the fore-mentioned disc-like object and the center position from the specific point on the fore-mentioned common perpendicular bisector and 2 pairs of intersections with respect to the common perpendicular bisector.

16. (Original) An automatic positioning device of a disc-like object according to Claim 15, wherein the locus of the fore-mentioned detection means is a circular arc.

17. (Currently Amended) An automatic carrying device of a disc-like object with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim, equipped with the automatic positioning device of a disc-like object according to Claim 15-~~or~~ 16,

a correction means of correcting a carrying route preliminarily taught of a holding portion of a carrying device based on a transition quantity which was calculated by the fore-mentioned positioning method, and

a means of carrying the fore-mentioned disc-like object to a fixed carrying position with the fore-mentioned holding portion along the fore-mentioned carrying route corrected,

by controlling the operation of the fore-mentioned holding portion of the fore-mentioned carrying device.

18. (Original) A method for automatically teaching a reference position which is the reference of the position of a disc-like object in the reference co-ordinate system including the position of a handling device of the fore-mentioned disc-like object, comprising a step of placing the disc-like object with an unknown radius at a fixed place which is the reference position,

a step of determining the center position of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system and a step of memorizing the position of the fore-mentioned fixed place in the fore-mentioned reference co-ordinate system which was determined by calculation based on the fore-mentioned center position in the fore-mentioned handling device as the reference position,

wherein the step of determining the center position of the fore-mentioned disc-like object comprises

a step of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means against the fore-mentioned disc-like object, and

a step of determining the center position using at least 3 points of the fore-mentioned co-ordinate positions detected and the formula of a circumference.

19. (Original) An automatic teaching method of a disc-like object according to Claim 18, wherein in place of a step of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means, the fore-mentioned at least 3 points on the peripheral rim of the fore-mentioned disc-like object are detected by 3 or more of one-point detecting type detection means, and the fore-mentioned 3 or more of detection means comprise a step of detecting at least 3 points by respectively crossing once relatively against the peripheral rim of the fore-mentioned disc-like object.

20. (Currently Amended) An automatic teaching method of a disc-like object according to Claim 18 ~~or~~ 19, wherein the fore-mentioned detection means comprises a step of crossing with the peripheral rim of the fore-mentioned disc-like object by relatively drawing

an O-character type, V-character type, U-character type, L-character type or C-character type locus against the fore-mentioned disc-like object.

21. (Currently Amended) An automatic teaching method of a disc-like object according to ~~any one of Claims~~Claim 18 to 20, wherein the fore-mentioned disc-like object is one with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim, at least 3 points detected on the peripheral rim of the fore-mentioned disc-like object are 4 points or more, when all of the radii or center positions which were determined from the formula of a circumference coincide with respect to all of combinations which 3 points among the fore-mentioned 4 points or more constitute, the value is selected and when they do not coincide, the detection of the fore-mentioned 4 points or more are repeated until they coincide.

22. (Original) A method for automatically positioning the fore-mentioned disc-like object with an unknown radius in the reference co-ordinate system including the position of a handling device of the disc-like object, comprising a step of determining the center position of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system and a step of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the step of determining the center position of the fore-mentioned disc-like object comprises a step of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means against the fore-mentioned disc-like object, and

a step of determining the center position using at least 3 points of the fore-mentioned co-ordinate positions detected and the formula of a circumference.

23. (Original) An automatic positioning method of a disc-like object according to Claim 22, wherein in place of a step of detecting at least 3 points on the peripheral rim of the disc-like object by the fore-mentioned one one-point detecting type detection means, the fore-mentioned at least 3 points on the peripheral rim of the fore-mentioned disc-like object are detected by 3 or more of one-point detecting type detection means, and the fore-mentioned 3

or more of detection means comprise a step of detecting at least 3 points by respectively crossing once relatively against the peripheral rim of the fore-mentioned disc-like object.

24. (Currently Amended) An automatic positioning method of a disc-like object according to Claim 22 ~~or 23~~, wherein the fore-mentioned step of detecting at least 3 points comprises a step of crossing with the peripheral rim of the fore-mentioned disc-like object by relatively drawing an O-character type, V-character type, U-character type, L-character type or C-character type locus against the fore-mentioned disc-like object.

25. (Currently Amended) An automatic positioning method of a disc-like object according to ~~any one of Claims~~ Claim 22 to 24, wherein the fore-mentioned disc-like object is one with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim, at least 3 points detected on the peripheral rim of the fore-mentioned disc-like object are 4 points or more, when all of the radii or center positions which were determined from the formula of a circumference coincide with respect to all of combinations which 3 points among the fore-mentioned 4 points or more constitute, the value is selected and when they do not coincide, the detection of the fore-mentioned 4 points or more are repeated until they coincide.

26. (Currently Amended) An automatic carrying method of a disc-like object using the automatic positioning method of the disc-like object according to ~~any one of Claims~~ Claim 22 to 25, comprising

a step of correcting a carrying route preliminarily taught of a holding portion of a carrying device as the fore-mentioned handling device based on a transition quantity which was calculated by the fore-mentioned positioning method, and

a step of carrying the fore-mentioned disc-like object to a fixed carrying position with the fore-mentioned holding portion of the fore-mentioned carrying device along the fore-mentioned carrying route corrected.

27. (Original) A device for automatically teaching a reference position which is the reference of the position of a disc-like object in the reference co-ordinate system including the position of a handling device to the handling device of the fore-mentioned disc-like object, equipped with a means of determining the center position of a disc-like object with an

unknown radius which was situated at a fixed place being the reference position in the fore-mentioned reference co-ordinate system and a means of memorizing the position of the fore-mentioned fixed place in the fore-mentioned reference co-ordinate system which was determined by calculation based on the fore-mentioned center position in the fore-mentioned handling device as the reference position,

wherein the means of determining the center position of the fore-mentioned disc-like object is equipped with

a means of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means against the fore-mentioned disc-like object, and

a means of determining the center position using at least 3 points of the fore-mentioned co-ordinate positions detected and the formula of a circumference.

28. (Original) An automatic teaching device of a disc-like object according to Claim 28, wherein in place of a means of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means, the fore-mentioned at least 3 points on the peripheral rim of the fore-mentioned disc-like object are detected by 3 or more of one-point detecting type detection means, and the fore-mentioned 3 or more of detection means comprise a step of detecting at least 3 points by respectively crossing once relatively against the peripheral rim of the fore-mentioned disc-like object.

29. (Currently Amended) An automatic teaching device of a disc-like object according to Claim 27-~~or 28~~, wherein the fore-mentioned detection means crosses with the peripheral rim of the fore-mentioned disc-like object by relatively drawing an O-character type, V-character type, U-character type, L-character type or C-character type locus against the fore-mentioned disc-like object, in a means of detecting the fore-mentioned at least 3 points.

30. (Currently Amended) An automatic teaching device of a disc-like object according to ~~any one of Claims~~ Claim 27 to 29, wherein the fore-mentioned disc-like object is one with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim, the fore-mentioned at least 3 points detected on the peripheral rim of the

fore-mentioned disc-like object are 4 points or more in a means of detecting the fore-mentioned at least 3 points, when all of the radii or center positions which were determined from the formula of a circumference coincide with respect to all of combinations which 3 points among the fore-mentioned 4 points or more constitute, the value is selected and when they do not coincide, the detection of the fore-mentioned 4 points or more are repeated until they coincide.

31. (Original) A device for automatically positioning the fore-mentioned disc-like object with an unknown radius in the reference co-ordinate system including the position of a handling device of the disc-like object, equipped with a means of determining the center position of the fore-mentioned disc-like object in the fore-mentioned reference co-ordinate system and

a means of calculating a transition quantity from the center position preliminarily taught to the fore-mentioned center position determined in the fore-mentioned reference co-ordinate system,

wherein the means of determining the center position of the fore-mentioned disc-like object comprises a means of detecting at least 3 points on the peripheral rim of the disc-like object by the relative movement of one one-point detecting type detection means against the fore-mentioned disc-like object, and

a means of determining the center position using at least 3 points of the fore-mentioned co-ordinate positions detected and the formula of a circumference.

32. (Original) An automatic positioning device of a disc-like object according to Claim 31, wherein in place of a means of detecting at least 3 points on the peripheral rim of the disc-like object in the fore-mentioned one one-point detecting type detection means, a means of detecting at least 3 points on the peripheral rim of the fore-mentioned disc-like object by 3 or more of one-point detecting type detection means comprises a means of detecting at least 3 points by respectively crossing once relatively against the peripheral rim of the fore-mentioned disc-like object.

33. (Currently Amended) An automatic positioning device of a disc-like object according to Claim 31 ~~or 32~~, wherein the fore-mentioned detection means crosses with the peripheral rim of the fore-mentioned disc-like object by relatively drawing an O-character

type, 'V-character type, U-character type, L-character type or C-character type locus against the fore-mentioned disc-like object, in a means of detecting the fore-mentioned at least 3 points.

34. (Currently Amended) An automatic positioning device of a disc-like object according to ~~any one of Claims~~Claim 31 ~~to 33~~, wherein the fore-mentioned disc-like object is one with an unknown radius having one concave portion or one convex portion at one portion of peripheral rim, the fore-mentioned at least 3 points detected on the peripheral rim of the fore-mentioned disc-like object are 4 points or more in a means of detecting the fore-mentioned at least 3 points, when all of the radii or center positions which were determined from the formula of a circumference coincide with respect to all of combinations which 3 points among the fore-mentioned 4 points or more constitute, the value is selected and when they do not coincide, the detection of the fore-mentioned 4 points or more are repeated until they coincide.

35. (Currently Amended) An automatic carrying device of a disc-like object using the automatic positioning device of the disc-like object according to ~~any one of Claims~~Claim 31 ~~to 34~~, equipped with a means of correcting a carrying route preliminarily taught of a holding portion of a carrying device as the fore-mentioned handling device based on a transition quantity which was calculated by the fore-mentioned positioning method, and

a means of carrying the fore-mentioned disc-like object to a fixed carrying position with the fore-mentioned holding portion of the fore-mentioned carrying device along the fore-mentioned carrying route corrected.

36. (Currently Amended) An automatic semiconductor manufacturing equipment equipped with ~~at least one of the~~ automatic reference position teaching device of a disc-like object according to ~~any one of Claims~~Claim 7, 8 ~~and 27 to 30~~,
—— ~~the automatic positioning device of a disc-like object according to any one of Claims 9 to 11, 15, 16 and 31 to 34, and the automatic carrying device of a disc-like object of a disc-like object according to any one of Claim 12, 17 or 35.~~

37. (New) An automatic semiconductor manufacturing equipment equipped with the automatic reference position teaching device of a disc-like object according to Claim 27.

38. (New) An automatic semiconductor manufacturing equipment equipped with the automatic reference position teaching device of a disc-like object according to Claim 9.

39. (New) An automatic semiconductor manufacturing equipment equipped with the automatic reference position teaching device of a disc-like object according to Claim 10.

40. (New) An automatic semiconductor manufacturing equipment equipped with the automatic reference position teaching device of a disc-like object according to Claim 15.

41. (New) An automatic semiconductor manufacturing equipment equipped with the automatic reference position teaching device of a disc-like object according to Claim 31.